

WHAT IS CLAIMED IS:

1. A system, comprising:

an exciter disposed to impinge at least one exciter beam
5 onto a remote mass to excite the mass;
an optical probe disposed to impinge at least one
optical beam onto a vibrating surface of the excited mass to
be reflected thereby;
a laser vibrometer disposed to detect at least part of
10 the optical beam reflected by the vibrating surface of the
excited mass and configured to generate signals indicative of
the surface vibrations;
a processor configured to store and reverse the signals
generated by the laser vibrometer; and
15 a modulator configured to modulate the at least one
exciter beam generated by the exciter in accordance with the
reversed signals.

2. The system of claim 1, wherein the exciter is selected
20 from the group of exciters comprised of laser sources
configured to impinge at least one laser exciter beam onto
the remote mass to excite the mass, and acoustic sources
configured to impinge at least one acoustic exciter beam onto
the remote mass to excite the mass.

3. The system of claim 2, wherein the processor is configured to store the signals as a series of pulses and to 5 reverse the stored pulses in a first in, last out (FILO) sequence.

4. The system of claim 3, wherein the processor comprises: a cache memory to store the signals.

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5. The system of claim 3, wherein the processor comprises: a programmable delay line network.

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6. The system of claim 5, wherein the processor comprises: a cache memory to store the signals.

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7. The system of claim 2, wherein the exciter is a pulsed laser source for impinging an optical beam onto the remote mass to excite the mass.

8. The system of claim 2, wherein the laser vibrometer is a compensated laser vibrometer.

9. The system of claim 8, wherein the laser vibrometer comprises:

an adaptive photodetector for detecting a plurality of speckles from the optical beam reflected by the vibrating
5 surface of the excited mass.

10. The system of claim 2, further comprising:

a plurality of laser vibrometers disposed to detect a plurality of speckles from the optical beam reflected by the
10 vibrating surface of the excited mass and configured to generate signals indicative of the surface vibrations.

11. The system of claim 10, wherein the plurality of laser vibrometers are disposed in a predetermined array.

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12. The system of claim 11, wherein the predetermined array of laser vibrometers is a phased array.

13. The system of claim 11, wherein the processor comprises:
20 a plurality of programmable delay line networks, each configured to store and reverse the signals generated by a respective one of the plurality of vibrometers.

14. A system, comprising:

a first laser source disposed to impinge at least one first optical beam onto a remote mass to excite the mass;

5 a second laser source disposed to impinge at least one second optical beam onto a vibrating surface of the excited mass to be reflected thereby;

10 a laser vibrometer disposed to detect one or more speckles from the second optical beam reflected by the vibrating surface of the excited mass and configured to generate signals indicative of the surface vibrations;

 a processor configured to store and reverse the signals generated by the laser vibrometer; and

15 a modulator configured to modulate the at least one first beam generated by the first laser source in accordance with the reversed signals.

15. The system of claim 14, wherein the processor is configured to store the signals as a series of pulses and to reverse the stored pulses in a first in, last out (FILO) sequence.

20 16. The system of claim 15, wherein the processor comprises:
 a cache memory to store the signals.

17. The system of claim 15, wherein the processor comprises:
a programmable delay line network.

18. The system of claim 17, wherein the processor comprises:
5 a cache memory to store the signals.

19. The system of claim 14, wherein the first laser source
is a pulsed laser source.

10 20. The system of claim 14, further comprising:
beam clean-up optics disposed to combine one or more
speckles from the second optical beam reflected by the
vibrating surface of the excited mass into a single coherent
beam for detection by the laser vibrometer.

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21. The system of claim 14, wherein the laser vibrometer is
a compensated laser vibrometer.

22. The system of claim 21, wherein the laser vibrometer
20 comprises:

an adaptive photodetector for detecting a plurality of
speckles from the second optical beam reflected by the
vibrating surface of the excited mass.

23. The system of claim 14, further comprising:

a plurality of laser vibrometers disposed to detect a plurality of speckles from the beam reflected by the vibrating surface of the excited mass and configured to generate signals indicative of the surface vibrations.

24. The system of claim 23, wherein the plurality of laser vibrometers are disposed in a predetermined array.

10 25. The system of claim 24, wherein the predetermined array of laser vibrometers is a phased array.

26. The system of claim 24, wherein the processor comprises:
a plurality of programmable delay line networks, each
15 configured to store and reverse the signals generated by a respective one of the plurality of vibrometers.

27. A time reversal mirror, comprising:

a laser vibrometer disposed to detect one or more
20 speckles from an optical beam reflected by a vibrating surface of a remote excited mass and configured to generate signals indicative of the surface vibrations;

a processor configured to store and reverse the signals generated by the laser vibrometer;

an exciter disposed to impinge an exciter beam onto the remote mass; and

a modulator configured to modulate the exciter beam in accordance with the reversed signals.

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28. The time reversal mirror of claim 27, wherein the exciter is selected from the group of exciters comprised of laser sources configured to impinge at least one laser exciter beam onto the remote mass, and acoustic sources configured to impinge at least one acoustic exciter beam onto the remote mass.

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29. The time reversal mirror of claim 28, wherein the processor is configured to store the signals as a series of pulses and to reverse the stored pulses in a first in, last out (FILO) sequence.

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30. The time reversal mirror of claim 29, wherein the processor comprises:

20 a cache memory for storing the signals.

31. The time reversal mirror of claim 29, wherein the processor comprises:

a programmable delay line network.

32. The time reversal mirror of claim 31, wherein the processor comprises:

a cache memory for storing the signals.

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33. The time reversal mirror of claim 27, wherein the exciter is a pulsed laser source for impinging an optical beam onto the remote mass to excite the mass.

10 34. The time reversal mirror of claim 33, wherein the laser vibrometer is a compensated laser vibrometer.

35. The time reversal mirror of claim 27, wherein the laser vibrometer comprises:

15 an adaptive photodetector for detecting a plurality of speckles from the optical beam reflected by the vibrating surface of the excited mass.

20 36. The time reversal mirror of claim 27, further comprising:

a plurality of laser vibrometers disposed to detect a plurality of speckles from the optical beam reflected by the vibrating surface of the excited mass and configured to generate signals indicative of the surface vibrations.

37. The time reversal mirror of claim 36, wherein the plurality of laser vibrometers are disposed in a predetermined array.

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38. The time reversal mirror of claim 37, wherein the predetermined array of laser vibrometers is a phased array.

39. The time reversal mirror of claim 37, wherein the
10 processor comprises:

a plurality of programmable delay line networks, each configured to store and reverse the signals generated by a respective one of the plurality of vibrometers.

15 40. A method, comprising:

selecting a laser vibrometer configured to generate signals indicative of detected optical beams;

disposing the laser vibrometer to detect one or more speckles from an optical beam reflected by a vibrating
20 surface of a remote excited mass and to generate signals indicative of the surface vibrations;

providing the signals generated by the laser vibrometer to a processor to store and reverse the signals;

generating an exciter beam to impinge onto the remote mass to excite the mass; and

modulating the exciter beam in accordance with the reversed signals.

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41. The method of claim 40, wherein generating the exciter beam comprises:

generating an exciter beam selected from the group comprised of laser beams and acoustic beams.

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42. The method of claim 41, wherein providing the signals to the processor comprises:

providing the signals to the processor to store the signals as a series of pulses and to reverse the stored pulses in a first in, last out (FILO) sequence.

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43. The method of claim 41, wherein providing the signals to the processor comprises:

providing the signals to the processor to store and reverse the signals in a programmable delay line network.

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44. The method of claim 41, wherein generating the exciter beam comprises:

generating a pulsed laser beam.

45. The method of claim 41, wherein selecting the laser vibrometer comprises:

selecting a compensated laser vibrometer.

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46. The method of claim 45, wherein selecting the laser vibrometer comprises:

selecting a compensated laser vibrometer comprising an adaptive photodetector for detecting a plurality of speckles from the optical beam reflected by the vibrating surface of the excited mass.

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47. The method of claim 41, further comprising:

disposing a plurality of laser vibrometers to detect one or more speckles from the optical beam reflected by the vibrating surface of the remote excited mass, each laser vibrometer configured to generate signals indicative of the surface vibrations.

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20 48. The method of claim 47, wherein disposing the plurality of laser vibrometers comprises:

disposing the plurality of laser vibrometers in a predetermined array.

49. The method of claim 48, wherein disposing the plurality of laser vibrometers comprises:

disposing the plurality of laser vibrometers in a phased array.

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50. The method of claim 48, wherein providing the signals to the processor comprises:

providing the signals to the processor to store and reverse the signals generated by each one of the plurality of 10 vibrometers in a respective one of a plurality of programmable delay line networks.

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